SURFACE CONTAMINATION DUE TO STORED RADIOACTIVE STEEL AND CONCRETE

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A large variety of shielding materials, (principally steel and concrete) are presently being stored at Fermilab for use in future facilities. The major portion of this material has come from other accelerators, now decommissioned (e.g., the ANL ZGS) and is thus radioactive. The personnel exposure to this material is controlled using the procedures of the Fermilab Radiation Guide. Since almost all of this material is stored outdoors, surface contamination of the radioactivity due to exposure to the weather is a possibility requiring investigation.

During the summer of 1981 we attempted to examine this possibility by sampling various radioactive components in storage and the soil directly beneath such components. All components tested had been in place for at least one year prior to these measurements. In each case maximum contact count rates with a Thyac meter (1" x 1" NaI (Tℓ) crystal) are given. The samples of both stored object and the soil were taken at the hottest possible locations in order to obtain upper limits.

These samples were counted on the Fermilab Counting Lab GeLi detectors for specific activity and by Eberline in West Chicago for ^{3}H. Errors are based upon one standard deviation statistical errors. All tritium concentrations were found to be insignificant compared to background which is not surprising because of the ability of tritium to wash away.

Each of three sampling locations and its results is described in detail below:

Industrial Area:

Samples taken at midpoint of the Neutrino Department steel storage area from a source of 3' x 6' steel (contact reading = 2.0×10^5 cts/min) include: rust chips from atop the source, a gravel sample taken directly beside, and a soil sample taken directly underneath the gravel sample.

Sample	Nuclide	Energy (keV)	Conc. (pCi/gm)	% err
Rust	Mn-54	834.8	832	4
"	C0-60	1173.2	187	6
"	C0-60	1332.5	204	6
Gravel	Mn-54	834.8	1.2	9
"	C0-60	1173.2	38	14
Soil	Mn-54	834.8	.3	15
"	C0-60	1173.2	.5	12
"	C0-60	1332.5	.5	12

Road C-1: (Between Neutrino and P-West)

Samples were taken in the middle of the storage area of road C-1. From this location of stored steel, samples from a 1' x 2' piece of steel (contact reading = $4.0 \cdot 10^6$ counts/min) included: a steel scrap, rust chips from the side, and a soil sample taken directly beneath the gravel sample.

Sample	Nuclide	Energy (keV)	Conc. (pCi/gm)	% err
Steel Block	Mn-54	834.8	1349	4
" "	C0-60	1173.2	2000	4
" "	C0-60	1332.5	2000	4
Rust Chips*	Mn-54	834.8	6	4
" "	C0-60	1173.2	205	4
" "	Na-22	1274.5	6	15
" "	C0-60	1332.5	209	4
Soil	Mn-54	834.8	.5	12
"	C0-60	1173.2	.7	12
"	C0-60	1332.5	.9	11

*The rust chips from another measure of the source concentration.

The gravel sample contained all natural radioactivity.

Kautz Road:

Samples taken atop and below concrete shielding for the antiproton rings and target area (contact reading = 2.0×10^4 cts/min) just off Kautz Road. Samples included concrete chips and a soil sample.

Sample	Nuclide	Energy (keV)	Conc. (pCi/gm)	% err
Concrete chips	Na-22	1274.5	22	7
" "	C0-60	1332.5	2	26

(all other samples showed natural radioactivity only).

Conclusion

The ratio between the source concentrations and the soil concentrations of these areas as, for example, in the Industrial Area are in the order of 2400:1 (Mn-54) and 400.1 (C0-60, E=1173 keV). This relationship is further evidenced by the source to soil ratio of the Rd. C-1 location. Concentration ratios of approximately 2700 to 1 for Mn-54, and 2500:1 for C0-60 (E=1173 keV and 1332 keV). Further support to refute the tendency toward high radioactivity concentrations in soil is evidenced by "all natural" concentrations in soil samples taken near several sources of concentrations less than 1000 pCi/gm. It would seem that the soil concentration of those radionuclides (principally ^{54}Mn and ^{60}Co) is safely less than one per cent. Future measurements should be made to determine if the same is true for tritium.